

NON-PUBLIC?: N  
ACCESSION #: 9405230305  
LICENSEE EVENT REPORT (LER)

FACILITY NAME: Browns Ferry Nuclear Plant (BFN) Unit 2 PAGE: 1 OF 7

DOCKET NUMBER: 05000260

TITLE: Unit 2 Reactor Automatically Scrammed When Main Steamline  
Isolation Valves Unexpectedly Closed  
EVENT DATE: 04/18/94 LER #: 94-005-00 REPORT DATE: 05/16/94

OTHER FACILITIES INVOLVED: DOCKET NO: 05000

OPERATING MODE: N POWER LEVEL: 15

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR  
SECTION:  
50.73(a)(2)(iv)

LICENSEE CONTACT FOR THIS LER:  
NAME: Clare S. Hsieh, Compliance TELEPHONE: (205) 729-2635  
Licensing Engineer

COMPONENT FAILURE DESCRIPTION:  
CAUSE: X SYSTEM: SB COMPONENT: FD MANUFACTURER: G080  
REPORTABLE NPRDS: N

SUPPLEMENTAL REPORT EXPECTED: NO

ABSTRACT:

On April 18, 1994, at approximately 0355 hours CDST, the Unit 2 reactor automatically scrammed from 15 percent power when the Main Steamline Isolation Valves (MSIVs) unexpectedly closed. MSIV closure was caused by low main steam pressure when six main turbine Bypass Valves (BPVs) spuriously opened to their full open position. Engineered Safety Feature (ESF) systems responded as designed. These systems included the automatic isolation or actuation of primary containment isolation system groups 2, 3, 6, and 8. This event is reported in accordance with 10 CFR 50.73 (a)(2)(iv) as an event that resulted in the automatic actuation of any ESF, including the reactor protection system.

TVA determined that the most likely cause of the BPVs opening was an Electro-Hydraulic Control (EHC) system malfunction. A defective pressure regulator potentiometer was found in the EHC circuitry.

The defective potentiometer was replaced and satisfactorily tested before the restart of Unit 2. TVA will perform a failure investigation of the defective potentiometer and reevaluate preventive maintenance actions for other sensitive system potentiometers. While there have been a number of previous reactor trips due to EHC/turbine control problems, there were no previous similar reactor scrams caused by multiple BPVs opening unexpectedly.

END OF ABSTRACT

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## I. PLANT CONDITIONS

Unit 2 was in a reactor startup from a hot standby condition. The reactor was at approximately 15 percent power (461 megawatts thermal) in "RUN" mode. The reactor pressure was at 938 psig and the reactor water level at +32 inch. The main turbine was not on line. Steam flow was being passed to the main condenser through the main turbine Bypass Valves (BPVs). BPVs 1, 2, and 3 were fully open; BPV 4 was approximately 60 percent open; and BPVs 5 through 9 were fully closed.

## II. DESCRIPTION OF EVENT

### A. Event:

On April 18, 1994, at approximately 0355 hours Central Daylight Savings Time (CDST), the Unit 2 reactor (RCT) automatically scrammed from 15 percent power when the Main Steamline Isolation Valves (MSIVs) ISV1 closed due to a Primary Containment Isolation System (PCIS) JM1 actuation that was caused by low main steam pressure. The six main turbine BPVs FCV1 that were shut or partially open (valves 4 through 9) spuriously opened to their full open position causing the low steam pressure. The low steam pressure resulted in the MSIVs closing which caused the reactor to scram. 1\_ /

The MSIV closure and reactor scram resulted in the temporary lowering of the reactor water level. Engineered Safety Feature (ESF) systems JE1 responded to the low reactor water level according to the plant design. The low reactor level caused isolation or actuation of the following PCIS actuations as expected:

- o PCIS group 2, drywell sump discharge VB! and shutdown cooling mode of Residual Heat Removal BO! system

- o PCIS group 3, Reactor Water Cleanup CE! system

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1\_/ Due to increasing bypass steam flow through the spuriously opened main turbine BPVs, the reactor pressure decreased to a minimum of 664 psig (the low steam pressure isolation setpoint is set at 843 psig) and the MSIVs automatically closed. With the reactor in "RUN" mode, when the MSIVs reached their 90-percent open limit switch position, the reactor scrammed as designed.

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- o PCIS group 6, Primary and Secondary Containment Purge and Vent JM!, Unit 2 Reactor Zone ventilation VB!; Refuel Zone Ventilation (VA); Standby Gas Treatment (SBGT)BH!, and Control Room Emergency Ventilation (CREV) VI) system

- o PCIS group 8, Traversing Incore Probe (IG! withdrawal

The reactor was stabilized in the hot shutdown condition pending investigation of the cause of the spurious opening of the main turbine BPVs. Operations personnel (utility, licensed) reset the ESF logic and restored the ESF systems to their normal standby alignment by 0415 hours on April 18, 1994.

This event is reported in accordance with 10 CFR 50.73(a)(2)(iv) as an event that resulted in the automatic actuation of any ESF, including the Reactor Protection System (RPS) JB!.

B. Inoperable Structures, Components, or Systems that Contributed to the Event:

None.

C. Dates and Approximate Times of Major Occurrences:

April 17, 1994 at  
2300 CDST Reactor was being started up from hot standby condition and was at rated temperature and pressure.

April 18, 1994 at  
0226 CDST Reactor placed in the "RUN" mode.

April 18, 1994  
from 0354 CDST  
to 0355 CDST Turbine BPVs 4-9 unexpectedly opened  
in sequence; 2\_ / reactor pressure  
decreased due to the increased bypass  
steam flow; all MSIVs closed and the  
reactor scrammed on MSIV limit switch  
position. PCIS groups 2, 3, 6, and 8  
actuated as expected when reactor  
water level dropped due to the MSIV  
closure/reactor scram.

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2\_ / Main turbine BPVs 4-9 reached full open position within  
approximately 7 seconds and stayed open for several seconds  
before starting to close sequentially - total time of the  
bypass transient was about 25 seconds.

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April 18, 1994  
from 0400 CDST  
to 0415 CDST ESF logic reset and ESF systems  
restored to standby alignment.

April 18, 1994 at  
0622 CDST A four-hour non-emergency notification  
was made to NRC in accordance with 10  
CFR 50.72 (b)(2)(ii).

D. Other Systems or Secondary Functions Affected:

None.

E. Method of Discovery:

The reactor scram and ESF actuations were recognized by the  
Operations personnel upon receipt of alarm indications in the  
Control Room.

F. Operator Actions:

The scram was the result of MSIV closure due to the spurious opening of the main turbine BPVs. There were no operator actions that contributed to this event.

During this event, Operations personnel responded to the MSIV closure/reactor scram in accordance with the reactor scram procedure. The reactor was stabilized in hot shutdown condition with the process parameters of the reactor systems at normal values. Operations personnel reset the ESF system logic and restored ESF systems to standby alignment.

#### G. Safety System Responses:

Reactor safety systems responded to the reactor scram as designed. The low steam pressure resulted in the actuation of PCIS group 1 (closure of the MSIVs). PCIS groups 2, 3, 6 and 8 logic actuated when the reactor water level dropped below the scram/RPS logic setpoint of +11 inches. Feedwater flow from the reactor feedwater pumps subsequently increased the water level back to normal range.

All trains of SBT and CREV systems were isolated or actuated. These included the SBT isolation dampers DMP! and fans FAN!; reactor and refueling zone dampers; and CREV air handling unit fans and motors MO!.

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### III. CAUSE OF THE EVENT

#### A. Immediate Cause:

The main turbine BPVs spuriously opened to their full open position causing low steam pressure. The low steam pressure resulted in the MSIVs closing which caused the reactor to scram.

#### B. Root Cause:

After detailed functional checks of the EHC circuitry and re-creation of this scram event on the BFN simulator, TVA determined that the most likely cause of the BPVs opening was an Electro-Hydraulic Control (EHC) system malfunction.

During EHC component testing, a defective pressure regulator potentiometer was found in the EHC circuitry. Significant

voltage spiking was detected across the EHC pressure regulator setpoint potentiometer 3\_/ when it was exercised. Because of the sensitivity of its location in the EHC circuitry, this potentiometer spiking was determined to be the most likely cause of this event. To determine the specific failure mechanism involved, a failure investigation will be performed on the defective EHC pressure regulator potentiometer.

#### C. Contributing Factors:

None.

### IV. ANALYSIS OF THE EVENT.

In this event, the spurious opening of the main turbine BPVs caused a reactor vessel depressurization which resulted in lowering of the steam pressure. In approximately 25 seconds, the steam pressure reduced below the low pressure isolation setpoint, which triggered the closure of all MSIVs. This type of transient is an analyzed event and is fully within the design basis of the plant.

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3\_/ The EHC pressure regulator setpoint potentiometer is the device which directly inputs the pressure setpoint to the EHC pressure regulator for reactor pressure control. The BPV control circuits are very sensitive to any spurious input signals. Even small signal abnormalities at this point in the EHC circuit could cause large magnitude valve cycling. For example, a signal equivalent to only approximately 7 psig steam header pressure change is all that is required to fully open all nine BPVs.

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The reactor systems responded to the transient as expected, and plant safety was not compromised during the event. In addition, this event did not result in any adverse condition that could have affected the health and safety of plant personnel or the public.

### V. CORRECTIVE ACTIONS

#### A. Immediate Corrective Actions:

An incident investigation was initiated to determine the cause of the spurious opening of the turbine BPVs. A detailed

troubleshooting plan was executed, and functional check of the EHC circuitry was performed. The defective EHC pressure regulator setpoint potentiometer was replaced and the entire EHC system was satisfactorily tested before the restart of Unit 2 on April 20, 1994.

#### B. Corrective Actions to Prevent Recurrence:

Based on the identified failure mechanism of the defective EHC pressure regulator potentiometer, TVA will determine if any additional Preventive Maintenance (PM) actions for the EHC pressure regulator potentiometers are needed to be added to the PM program. In addition, other sensitive system potentiometers will be identified and their PM actions will be reevaluated for possible improvement.

To allow signal trending and analysis and to improve future capabilities to analyze EHC system performance and malfunctions, fifteen EHC system inputs were connected to the plant Integrated Computer System (ICS) via a temporary alteration. TVA will permanently connect these inputs to the ICS.

### VI. ADDITIONAL INFORMATION

#### A. Failed Components:

EHC Pressure Regulator Setpoint Potentiometer - Motor-Operated Potentiometer, General Electric Part Number 0736E894G0001

#### B. Previous LERs on Similar Events:

While there have been a number of previous reactor trips due to EHC/turbine control problem, there were no previous similar events of multiple BPVs opening unexpectedly.

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### VII. Commitments

1. TVA will perform a failure investigation of the defective EHC pressure regulator potentiometer to determine the specific failure mechanism involved by August 31, 1994.
2. Based on the results of the failure investigation, TVA will determine if any additional PM actions for the EHC pressure

regulator potentiometers need to be added to the PM program by October 7, 1994.

3. TVA will identify other sensitive system potentiometers and reevaluate their PM actions for possible improvement by June 27, 1994.

4. TVA will permanently connect EHC system inputs to the plant ICS by August 29, 1994.

Energy Industry Identification System (EIIS) system and component codes are identified in the text with brackets (e.g., XX!).

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TVA

Tennessee Valley Authority, Post Office Box 2000, Decatur, Alabama  
35609-2000

R. D. (Rick) Machon  
Vice President, Browns Ferry Nuclear Plant

MAY 16 1994

U.S. Nuclear Regulatory Commission 10 CFR 50.73  
ATTN: Document Control Desk  
Washington, D.C. 20555

Dear Sir:

BROWNS FERRY NUCLEAR PLANT (BFN) UNITS 1, 2, AND 3 - DOCKET NOS.  
50-259,  
50-260, AND 296 - FACILITY OPERATING LICENSE DPR-33, 52, AND 68 -  
LICENSEE EVENT REPORT (LER) 50-260/94005

The enclosed LER provides details concerning a Unit 2 reactor scram when the Main Steamline Isolation Valves (MSIVs) unexpectedly closed. Closure of the MSIVs was caused by low main steam pressure when the main turbine bypass valves spuriously opened to their full open position.

This report is submitted in accordance with 10 CFR 50.73(a)(2)(iv) as an event that resulted in the automatic actuation of any engineered safety feature, including the reactor protection system.

Sincerely,



R.D. Machon  
Site Vice President  
PAB 1E-BFN

Enclosure  
cc: See page 2

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U.S. Nuclear Regulatory Commission  
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MAY 16 1994

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